nutrición clínica y Dietética Hospitalaria

Artículo Original

Nutr Clín Diet Hosp. 2025; 45(2):131-139
DOI: 10.12873/452kamil

Nutrition education using video improves iron intake and dietary diversity among adolescents: a quasi-experimental study

Nabilah Mustafaina KAMIL[1], Nurzakiah HASAN[2], Veni HADJU[2], Abdul Razak THAHA[2], Healthy HIDAYANTY[2]

1 Master of Nutrition Science Departement, Faculty of Public Health, Hasanuddin University, Indonesia.
2 Department of Nutrition Science, Faculty of Public Health, Hasanuddin University, Indonesia.

Recibido: 10/marzo/2025. Aceptado: 20/abril/2025.

ABSTRACT

Background: Nutrition education is crucial for improving school children's nutritional knowledge, fostering positive attitudes towards food, and developing healthy eating habits to address the triple burden of malnutrition currently affecting adolescents. This study aims to determine the impact of nutrition education videos on iron intake and dietary diversity among adolescents living in Makassar, South Sulawesi, Indonesia.

Methods: This study was a quasi-experimental design using a non-randomized pre-post test with a control group. The intervention study involved 69 adolescents: 34 in the intervention group and 35 in the control group. Group assignment was determined by a lottery method from two selected schools with similar characteristics, located within the working area of a community health center (Puskesmas) with the highest prevalence of anemia in Makassar City. The intervention group received nutrition education through weekly educational videos, delivered every Friday for seven consecutive weeks, totalling seven videos. In contrast, the control group only received a single session of educational video exposure over one week. To ensure full exposure to the intervention, all participants in the intervention group were required to watch all videos; those who missed any session were excluded from the study. Iron intake was assessed using the Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ), and dietary diversity was measured using a 24-hour dietary recall before and after the intervention. Data were analyzed using the Wilcoxon test to compare pre-test and post-test scores and the Mann-Whitney test to compare between groups.

Results: The intervention significantly increased both iron intake (P-value = 0.000, $p < 0.05$) and dietary diversity (P-value = 0.000, $p < 0.05$) in the intervention group compared to the control group.

Conclusion: Nutrition education effectively increased iron intake and dietary diversity in the intervention group compared to the control group.

KEYWORDS

Audiovisual material, behavioural changes, knowledge transfer, nutritional didactics.

INTRODUCTION

Indonesian adolescents today face three nutritional problems, known as the triple burden of malnutrition. These issues include undernutrition, overweight, and micronutrient deficiencies. Several factors contribute to the triple burden of malnutrition among adolescents in Indonesia, including decreased physical activity both inside and outside school, disrupted eating patterns, frequent consumption of fast food from outside the home, and a lack of dietary diversity. Approximately 1 in 4 adolescent girls in Indonesia experience anemia[1]. According to the 2023 Indonesia Health Survey, the prevalence of anemia in the 15-24 age group is 15.5%, with anemia among females (18%) being higher than among males (14.4%)[2]. Based on the Anemia Screening data conducted by the Makassar City Health Office in May 2024, the Jongaya Health Center had the highest prevalence at 53.16%, followed by the Mangasa Health Center at 42.5% and the Batua Health Center at 32.5%.

Untreated anemia in adolescents can persist into pregnancy[3], posing risks of negative impacts on fetal growth and development. Additionally, this condition increases the likelihood of various complications during pregnancy and child-

Correspondencia:
Nabilah Mustafaina Kamil
nabilahmustafainak@gmail.com

birth, such as a higher risk of low birth weight babies and increased maternal and infant mortality rates[4]. Iron deficiency anemia can be influenced by several factors, including inadequate consumption of animal-based iron sources (heme iron) and insufficient intake of nutrients that aid in iron absorption, such as protein and vitamin C[4]. Furthermore, dietary diversity among adolescent girls plays a crucial role in preventing macronutrient and micronutrient deficiencies that lead to anemia[5]. Adolescent girls with low dietary diversity scores are 47% more likely to experience anemia than those with adequate dietary diversity[6].

Various efforts can be made to prevent and address anemia among adolescents. In collaboration with the Indonesian government, UNICEF has developed a multisectoral national nutrition program targeting school-aged adolescents, known as the "Aksi Bergizi" program. This initiative aims to address the triple burden of malnutrition among Indonesian adolescents by preventing anemia through the promotion of healthy eating behaviors and physical activity. The program includes three main components: iron supplementation, nutrition education, and behavior change communication[7]. However, despite being a national program, it has not yet been fully implemented across all regions in Indonesia[8]. The effectiveness of "Aksi Bergizi" as a national program remains suboptimal due to gaps in delivery and coordination among sectors. As a result, nutrition education delivered by teachers using the "Aksi Bergizi" module has not been adequately implemented.

Initial observations among high school students in five schools within the Makassar health centers with the highest anemia prevalence revealed that adolescent girls still have minimal knowledge about anemia. This finding is supported by a study by Rahayu et al. (2022), which found that adolescent girls in one high school in Makassar had low knowledge about anemia and its prevention despite having a positive attitude. Preventive measures against anemia among adolescent girls were also found to be insufficiently practiced. Therefore, educational efforts supported by other promotional approaches need to be enhanced within this group to promote behavior change for better anemia prevention and improve the success of anemia prevention programs for adolescent girls in Indonesia[9].

Several studies have demonstrated the effectiveness of educational videos in increasing knowledge and attitudes. For example, research by Farhan et al. (2023) showed that video-based media improved adolescent girls' knowledge and attitudes about anemia before and after an intervention[10]. Another study found that educational videos positively influenced adherence to iron supplementation among adolescent girls[11]. However, the impact of educational videos on iron intake and dietary diversity remains underexplored and has not shown significant changes. Research by Farhan et al. (2023) indicated that video-based education did not significantly affect dietary diversity[10], and its impact on iron intake has not yet shown meaningful results. These studies provided educational interventions only one to three times, which may explain the lack of significant findings[12].

Previous studies have shown that education through video media can improve adolescent girls' knowledge, attitudes, and behaviours. However, research on its impact on iron intake and dietary diversity remains limited and has not yet fully demonstrated positive results. Therefore, the researchers are interested in strengthening this approach by modifying the Nutrition Education in "Aksi Bergizi" program into video media to improve iron intake and dietary diversity among adolescent girls.

MATERIALS AND METHODS

Research Design and Location

The research used a quasi-experimental design with a non-randomized pre-post test with a control group design. The purpose of using a quasi-experimental design was to measure the effect of the "Aksi Bergizi" educational video on iron intake and dietary diversity among adolescent girls in anemia prevention. This study was conducted from August 2024 to November 2024, covering the preparation, intervention, and data processing phases. The selection of schools was based on similar characteristics, including location within the same area, comparable environmental conditions, and relatively homogeneous socioeconomic backgrounds. In addition, both schools had comparable curricula and access to information. The assignment of intervention and control groups was carried out randomly through a lottery, resulting in SMAN 11 Makassar being designated as the intervention group and SMAN 8 Makassar as the control group.

Research Sample

The population in this study consisted of first-year female students at SMAN 8 Makassar and SMAN 11 Makassar. The study sample consisted of 72 adolescent girls. The intervention group (n=36) received seven video sessions based on the "Aksi Bergizi" guideline, while the control group (n=36) was given a single-session anemia prevention video from the Ministry of Health. The intervention provided to the control group reflected the natural conditions typically offered by public health centers.

Adolescent girls aged 15–18 who owned a smartphone with a WhatsApp account and were willing to participate in the research were included in the study. Students currently on a diet program and those suffering from chronic diseases such as cancer or infectious diseases like tuberculosis, pneumonia, HIV/AIDS, hepatitis, and malaria were excluded.

The dropout criteria were respondents who did not complete all research sessions, those who withdrew from the study, and respondents with a weekly quiz evaluation score

below 80%. Due to some respondents meeting the dropout criteria, the final sample consisted of 34 participants in the intervention group and 35 in the control group.

Instruments and Procedures

Before the intervention phase, baseline data on knowledge about anemia were collected from the entire study population. The purpose was to select a sample of adolescent girls with low levels of knowledge. This was intended to equalize the initial conditions of the sample as a quality control measure in evaluating the effectiveness of the educational video provided during the intervention.

The intervention was conducted over 9 weeks. In the first week, a pre-test was administered, followed by the delivery of educational materials from the second to the eighth week, and concluded with a post-test in the ninth week. The educational videos used in this study were based on the "Aksi Bergizi" module and were provided exclusively to the intervention group. The educational content focused on the prevention of anemia in adolescent girls, covering eight main topics: Anemia and Iron, Healthy Breakfast, My Plate (Isi Piringku), Protein: The Body Builder, Consumption of Vegetables and Fruits, Micronutrients, Balanced Nutrition, and Food and Beverage Labeling. These topics were compiled into seven educational videos, each with an average duration of approximately three minutes. Before the intervention, a video acceptance test assessing audio and visual aspects was conducted on students not part of the study sample (n=11).

The educational videos were delivered to the intervention group once a week, every Friday, through a WhatsApp Group. The videos were shared as Google Form links and a short quiz to monitor whether the respondents had watched them. Meanwhile, the control group received only a single session of video education titled "Kenali Anemia dan Cara Pencegahannya", sourced from the Ministry of Health of the Republic of Indonesia. This video was shown once during the first week of intervention (YouTube: https://youtu.be/2VXntDRYJlk?si=byurnJIx_NfDllU_).

Iron intake in this study was measured using a validated Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ), which demonstrated good reliability with a Cronbach's Alpha value of 0.740. The validity test was conducted on 30% of subjects outside the main study sample (n=11) from the working area of Jongaya Health Center. Food items consumed by at least three respondents were considered representative; therefore, out of the initial 105 food items, 100 were used in this study.

Dietary diversity was measured using the Minimum Dietary Diversity for Women (MDD-W) indicator through a 24-hour recall questionnaire. MDD-W is the latest global indicator for assessing diet quality and has been validated for adolescent girls aged 10–19 years[13]. All foods reported as consumed during the 24-hour recall were classified into the following ten food groups: Grains, white roots and tubers, plantains, Pulses (beans, peas, and lentils), Nuts and seeds, Milk and milk products, Meat, poultry, and fish, Eggs, Dark green leafy vegetables, Other vitamin A-rich fruits and vegetables, Other vegetables, Other fruits. A food item was counted if the amount consumed was ≥15 grams (approximately one tablespoon). Each food group received a score of 1 if the respondent consumed at least one food item from the group within 24 hours and 0 if they did not consume any item from that group[14].

This study has obtained ethical approval from the Faculty of Public Health Ethics Committee, Hasanuddin University, with approval number 2110/UN4.14.1/TP.01.02/2024.

Data Analysis

Data processing and analysis were carried out using the SPSS version 27 program. Before performing statistical tests to test the hypothesis, a normality test was conducted using the Shapiro-Wilk test. Next, a paired test using the Wilcoxon Test was applied to examine the effects before and after the intervention. The Mann-Whitney Test was used to analyze the differences between groups.

RESULT

Based on Table 1, it is known that most respondents involved in this study were 15 years old in both groups, with 27 adolescents (77%) in the intervention group and 28 adolescents (82.4%) in the control group. The father's education level in the intervention group was predominantly high school (SMA), with 20 individuals (57.1%), while in the control group, the majority also had a high school education, with 23 individuals (67.6%). Similarly, the mother's education level in both the intervention and control groups was predominantly high school, with 21 individuals (60%) in the intervention group and 19 individuals (55.9%) in the control group. Regarding the father's occupation, the majority were self-employed, with 14 individuals (40%) in the intervention group and 15 individuals (44.1%) in the control group. Meanwhile, most mothers were unemployed, with 29 individuals (82.9%) in the intervention group and 26 individuals (76.5%) in the control group. Based on cross-tabulation data analyzed using the Chi-Square test, the statistical values obtained were as follows: age (p=0.591), father's education (p=0.281), mother's education (p=0.758), father's occupation (p=0.083), and mother's occupation (p=0.501). These results indicate that the data between the two groups are homogeneous, meaning there is no significant difference.

Table 2 shows that the average iron intake in the intervention group increased from 5.33 (range: 0.41–12.8) in the pre-test to 9.70 (range: 5.42–12.46) in the post-test. In contrast, the control group experienced a decrease in iron intake from an average of 6.90 (range: 1.85–11.41) in the pre-test

Table 1. Characteristics of respondents

Variable	Group						*P-Value**
	Intervention		Control		Total		
	n (34)	%	n (35)	%	n (69)	%	
Age (Year)							
15	27	77.1	28	82.4	55	79.7	0.591
16	8	22.9	6	17.6	14	20.3	
Father's Education							
Primary Education	1	2.9	1	2.9	2	2.9	
Secondary Education	6	17.1	1	2.9	7	10.1	0.281
Higher Education	20	57.1	23	67.6	43	62.3	
Undergraduate/Bachelor/Master	8	22.9	9	26.5	17	24.6	
Mother's Education							
Primary Education	1	2.9	1	2.9	2	2.9	
Secondary Education	4	11.4	2	5.9	6	8.7	0.758
Higher Education	21	60	19	55.9	40	58	
Undergraduate/Bachelor/Master	9	25.7	12	35.3	21	30.4	
Father's occupation							
Unemployed	0	0.0	1	2.9	1	1.4	
Civil Servants	6	17.1	5	14.7	11	15.9	
Private-employee	4	11.4	10	29.4	14	20.3	0.083
Self-employed	14	40	15	44.1	29	42	
Labor	11	31.4	3	8.8	14	20.3	
Mother's occupation							
Unemployed	29	82.9	26	76.5	55	79.7	
Civil Servants	1	2.9	3	8.8	4	5.8	
Private-employee	1	2.9	3	8.8	4	5.8	0.501
Self-employed	3	8.6	2	5.9	5	7.2	
Labor	1	2.9	0	0.0	1	1.4	

*Chi-Square.

Table 2. Analysis of Differences in Iron Intake Among Adolescent Girls

Iron Intake	Pre-Test		Post-Test		P-Value	Δ		P-Value
	Mean±SD	Min-Max	Mean±SD	Min-Max		Mean±SD	Min-Max	
Intervention	5.33±2.62	0.41-12.8	9.70±4.15	0.78-14.62	**0.000**[a]	4.32±2.90	0.37-11.57	**0.000**[b]
Control	6.90±2.85	1.85-11.41	5.42±2.46	1.02-10.08	**0.000**[a]	-1.48±1.83	-4.39-2.24	

[a] Wilcoxon Signed Ranks Test. [b] Mann Witney Test.

to 5.42 (range: 1.02–10.08) in the post-test. The Wilcoxon Signed Rank Test results for iron intake in both the intervention and control groups before and after the intervention showed statistically significant values (p=0.000, p<0.05). Furthermore, the difference in iron intake between the intervention and control groups was tested using the Mann-Whitney test, yielding a P-value of 0.000 (p<0.05), indicating a significant difference between the two groups.

Based on Table 3, the analysis of differences in Dietary Diversity among adolescent girls shows an increase in the intervention group, with an average score rising from 2.71 (range: 1–4) in the pre-test to 4.06 (range: 1–7) in the post-test. In contrast, the control group showed only a slight increase, with an average score of 3.09 (range: 1–6) in the pre-test to 3.17 (range: 2–5) in the post-test. The Wilcoxon Signed Rank Test results in the intervention group before and after the intervention showed a statistically significant value (p=0.000, p<0.05). In contrast, in the control group, the result was not statistically significant (p=0.491, p>0.05). Furthermore, the difference in Dietary Diversity between the intervention and control groups was tested using the Mann-Whitney test, yielding a P-value of 0.000 (p<0.05), indicating a significant difference between the two groups.

process. The electricity supply in both schools comes from PLN, and internet access is available to support academic activities. Additionally, both schools have canteens within the premises that sell a variety of snacks, main meals, and beverages such as tea, coffee, and Pop Ice. Both schools are located in densely populated residential areas with easy access via the main road. They are also surrounded by various supporting facilities, such as food stalls, stationery shops, and public transportation options.

In this study, the majority of respondents were 15 years old, with most parents having a high school education, and fathers predominantly working as entrepreneurs in both groups. Parental education and occupation play a crucial role in influencing the food intake and dietary diversity of adolescent girls. Parental education plays a significant role in shaping the food intake and dietary diversity of adolescent girls[15,16]. Studies show that adolescent girls whose parents have higher levels of education are more likely to consume a diversified diet, as educated parents tend to have greater access to information promoting varied and healthy eating habits[17]. Additionally, parents with a higher education level are more likely to provide a supportive environment for healthy nutrition, which can positively influence their daughters' food choices and overall nutri-

Table 3. Analysis of Differences in Dietary Diversity Among Adolescent Girls

Dietary Diversity	Pre-Test		Post-Test		P-Value	Δ		P-Value
	Mean±SD	Min-Max	Mean±SD	Min-Max		Mean±SD	Min-Max	
Intervention	2.71±0.76	1-4	4.06±1.12	1-7	**0.000**[a]	1.35±1.34	(-2)-5	**0.000**[b]
Control	3.09±1.09	1-6	3.17±0.89	2-5	0.491[a]	0.08±0.74	(-1)-2	

[a] Wilcoxon Signed Ranks Test. [b] Mann Witney Test.

DISCUSSION

This study was conducted at SMAN 11 Makassar and SMAN 8 Makassar, with SMAN 11 Makassar designated as the intervention group and SMAN 8 Makassar as the control group. The characteristics of both schools are quite similar, as they are equipped with various facilities that support the learning

tional status[16]. Conversely, undernutrition is more prevalent among adolescent girls whose parents are illiterate, highlighting the importance of parental literacy in ensuring adequate nutrition for adolescents[15]. School-based nutrition education programs, especially those involving parents, can also improve dietary diversity among adolescent girls[18].

Parental employment also significantly influences the food intake and dietary diversity of teenage girls. Employment status and the nature of a parent's job can affect the time available for meal preparation and the resources allocated for food purchasing. For instance, working parents, especially those in lower-paying jobs, may face time constraints that limit their ability to prepare healthy meals, leading to a reliance on convenience foods that are often less nutritious. Research indicates that teenage girls from families where parents have higher educational backgrounds or stable employment tend to consume more fruits and vegetables and have a more varied diet compared to those whose parents work in less stable or lower-skilled positions[19]. Additionally, parental occupations can impact dietary habits through socioeconomic status; families with higher income levels typically have better access to diverse food options, which can promote healthier eating patterns among their children[20] vaidav. Therefore, the interplay between parental employment and dietary choices is crucial in shaping the nutritional landscape for adolescent girls.

Iron Intake

One strategy to prevent anemia among adolescents is nutrition education, which aims to provide information about appropriate nutrient intake and requirements, including iron, and to instill healthy eating habits. Knowledge influences a person's attitude, affecting their behavior[21]. In this study, adolescent girls in the intervention group received seven sessions of nutrition education videos from the "Aksi Bergizi" program, while the control group was given a single video from the Ministry of Health on adolescent anemia prevention. Nutrition education is an effective and significant approach to improving nutritional knowledge, modifying behavior, and enhancing dietary intake among adolescents, ultimately helping them achieve good nutritional status[22].

The bivariate analysis of iron intake in the intervention group showed a significant increase before and after the intervention (p=0.000), whereas the control group experienced a significant decrease in intake before and after the intervention (p=0.000). The differing significance trends between the two groups may be due to the "Aksi Bergizi" video providing more comprehensive and continuous information. It may also be influenced by the duration and frequency of the intervention. Studies have shown that video interventions can effectively promote health behavior changes by enhancing knowledge, attitudes, and skills[23].

Several factors can influence the dietary intake of adolescent girls, including food preferences, eating habits, nutritional knowledge, and access to food[23]. The decrease in intake in the control group may be due to differences in data collection timing between the pre-test and post-test. During the pre-test, which included holidays, adolescent girls had broader access to various food choices and food availability at home. However, during the post-test, which took place on school days, the time spent at school limited their access to diverse foods, especially if the availability of healthy food in the school environment was restricted. This led to changes in eating patterns and reduced food intake compared to the pre-test period.

Although iron intake in the intervention group showed a significant increase, the respondents' average daily consumption after the intervention was 9.70 g/day, which is still below the recommended dietary allowance. Dietary intake practices among adolescents are strongly linked to socioeconomic status, food preferences, food selection skills, and availability[24]. Additionally, adolescent girls' knowledge of iron intake can influence their dietary behavior. A study by Yahia (2016) found that adolescents with higher nutrition knowledge were likelier to adopt better dietary behaviors regarding both macronutrients and micronutrients[25].

The difference in knowledge improvement between the two groups showed a p-value of 0.000, indicating that the effectiveness of the "Aksi Bergizi" video education was greater than that of the Ministry of Health video in increasing iron intake. This finding contrasts with a study by Dewi et al. (2023), which found no significant difference in iron intake before and after a video-based nutrition education intervention in either the intervention or control group[26]. This discrepancy may be due to the fact that the video-based education in Dewi et al.'s study was only delivered once, whereas dietary behavior change is a complex process influenced by internal factors (motivation, perception, emotion) and external factors (social environment, culture, policy). The time required for behavior change can vary depending on individual awareness, environmental support, and the intervention provided[27].

Educational videos can be a highly effective tool for increasing iron intake among adolescent girls. Studies show that video-based education significantly increases knowledge about anemia, which in turn promotes better consumption habits of iron supplements and a greater awareness of the importance of iron in the diet[28]. By using engaging and innovative media like animated videos, educators can effectively convey information, increase memory retention, and encourage behavioral changes that lead to improved iron intake and reduced risk of anemia among adolescent girls[29]. Video education has demonstrated positive impacts on knowledge, attitudes, and intentions regarding iron supplementation in adolescent girls[30].

Dietary Diversity

Dietary diversity is the variety of foods consumed across various food groups, including staple foods, protein sources, vegetables, and fruits. The greater the diversity of food consumed, the more nutrients the body receives to meet daily requirements, as no single food can provide all the essential nutrients the body needs[10]. A diverse diet includes various food

types across multiple groups, ensuring a balanced intake of essential nutrients. In this study, there was a significant increase in dietary diversity scores in the intervention group, from an average of 2.71 to 4.06. In contrast, the increase in dietary diversity scores in the control group was minimal, from 3.09 to 3.17. This indicates that adolescents tend to maintain a monotonous and limited dietary pattern without specific education or intervention. According to Marquez et al. (2024), insufficient dietary diversity is reflected in a diet predominantly composed of cereals, with low intake of fruits, vegetables, and animal protein, which increases the risk of micronutrient deficiencies—particularly iron, which plays a clinically important role in women of reproductive age[31].

The bivariate analysis of dietary diversity in the intervention group showed a significant increase before and after the intervention (p=0.000), while the control group showed no significant difference before and after the intervention (p=0.491). The difference in knowledge improvement between the two groups resulted in a p-value of 0.000, indicating that the effectiveness of the "Aksi Bergizi" video education was greater than that of the Ministry of Health video in improving dietary diversity among adolescent girls.

A previous study conducted in Jakarta found no significant difference in dietary diversity before and after video-based education (p=0.177) [10]. One factor influencing the low level of dietary diversity among adolescents is the frequency of nutrition education. In that study, the education session was only conducted once without providing the video for rewatching. Another study has shown that the frequency of nutrition education is associated with food consumption levels. The study concluded that the more frequent the education sessions, the better adolescent dietary patterns. Students who received three nutrition education sessions had better dietary consumption patterns than those who only received one session. Thus, the frequency of education plays a crucial role in shaping adolescent girls' dietary habits[12].

Nutrition education is essential in improving dietary diversity across various populations, particularly among vulnerable groups such as children and adolescents. A community-based nutrition education study in Malawi significantly improved dietary diversity among children aged 6 to 23 months, demonstrating that effective nutrition education can positively change eating practices[32]. Another study found that a school-based nutrition education program in Bangladesh successfully increased dietary diversity scores among adolescent girls, leading to higher consumption of meat, vitamin A-rich fruits, vegetables, nuts, seeds, and legumes[18]. Overall, effective nutrition education is crucial for promoting dietary diversity and addressing malnutrition among at-risk populations[33].

School-based nutrition education, especially when employing audio-visual techniques, can effectively increase dietary diversity among adolescent girls. An interventional study in Bangladesh demonstrated that incorporating nutrition education into the school curriculum improved the dietary diversity of adolescent girls. These interventions often include educating girls on diversified food groups, their health benefits, and how to select diversified meals at a low cost[18]. In Ethiopia, a study found that girls exposed to such interventions reported higher dietary diversity scores, with many consuming at least five different food groups daily. This approach not only educates girls about healthy eating habits but also encourages them to share this knowledge with their families, fostering a community-wide impact on nutrition practices[17].

CONCLUSIONS AND RECOMMENDATIONS

Nutrition education through video increases iron intake and dietary diversity among adolescent girls. The implementation of this study was not without challenges and limitations. This research did not analyze confounding factors such as socioeconomic status, family support, and food availability, which may influence the effectiveness of the video education intervention on iron intake and dietary diversity. Therefore, future studies are encouraged to explore these factors to gain a more comprehensive understanding of how socioeconomic conditions, family support, and food availability impact the effectiveness of video-based nutrition education interventions on iron intake and dietary diversity.

REFERENCES

1. Rah JH, Melse-Boonstra A, Agustina R, van Zutphen KG, Kraemer K. The Triple Burden of Malnutrition Among Adolescents in Indonesia. Food Nutr Bull [Internet]. 2021;42(1_suppl):S4–8. Available from: https://journals.sagepub.com/doi/10.1177/03795721211007114?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub 0pubmed

2. Kemenkes RI. Survei Kesehatan Indonesia 2023 [Internet]. Kemenkes RI. 2024. Available from: https://www.badankebijakan.kemkes.go.id/hasil-ski-2023/

3. Chitekwe S, Torlesse H, Aguayo VM. Nutrition in Nepal: Three decades of commitment to children and women. Matern Child Nutr [Internet]. 2022;18(S1):1–8. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC8770654/pdf/MCN-18-e13229.pdf

4. Utama F, Rahmiwati A, Arinda DF. Prevalence of Anaemia and its Risk Factors Among Adolescent Girls. 2020;25(Sicph 2019):461–3. Available from: https://www.atlantis-press.com/proceedings/sicph-19/125941295

5. Agustina R, Nadiya K, El Andini A, Setianingsih AA, Sadariskar AA, Prafiantini E, et al. Associations of meal patterning, dietary quality and diversity with anemia and overweight-obesity among Indonesian schoolgoing adolescent girls in West Java. PLoS One [Internet]. 2020;15(4):1–19. Available from: http://dx.doi.org/10.1371/journal.pone.0231519

6. Habtegiorgis SD, Petrucka P, Telayneh AT, Shitu Getahun D, Getacher L, Alemu S, et al. Prevalence and associated factors of

anemia among adolescent girls in Ethiopia: A systematic review and meta-analysis. PLoS One [Internet]. 2022;17(3 March):1–11. Available from: http://dx.doi.org/10.1371/journal.pone.0264063

7. UNICEF. Program Gizi Remaja Aksi Bergizi: Dari Kabupaten Percontohan Menuju Perluasan Nasional. Unicef [Internet]. 2021;1–12. Available from: https://www.unicef.org/indonesia/media/9246/file/Program Gizi Remaja Aksi Bergizi dari Kabupaten Percontohan menuju Perluasan Program.pdf

8. Rachmi CN, Wulandari E, Kurniawan H, Wiradnyani LAA, Ridwan R, Akib TC. Aksi Bergizi Hidup Sehat Sejak Sekarang untuk Remaja Kekinian Penanggung. Unicef [Internet]. 2019;1–188. Available from: https://www.unicef.org/indonesia/media/2806/file/aksi-bergizi-siswa-2019.pdf

9. Indriasari R, Mansur MA, Srifitayani NR, Tasya A. Pengetahuan, Sikap, dan Tindakan Terkait Pencegahan Anemia Pada Remaja Berlatarbelakang Sosial-ekonomi Menengah ke Bawah di Makassar. Amerta Nutr [Internet]. 2022;6(3):256–61. Available from: https://doi.org/10.20473/amnt.v6i3.2022.256-261

10. Farhan K, Maulida NR, Lestari WA. PENGARUH EDUKASI ANEMIA MELALUI MEDIA VIDEO TERHADAP PENGETAHUAN, SIKAP, SERTA KEBERAGAMAN KONSUMSI MAKANAN REMAJA PUTRI DI SMP N EGERI 86 JAKARTA. 2024;13(September 2023):127–38. Available from: https://ejournal3.undip.ac.id/index.php/jnc/article/view/41172/31091

11. Septi P, Nadila Y, Rustam M. Pengaruh Edukasi Media Tiktok Terhadap Kepatuhan Konsumsi Tablet Tambah Darah Pada Remaja Putri. 2024;6(3):222–33. Available from: https://journalpedia.com/1/index.php/jrkm/article/view/2347/2365

12. Ningsih AL, Srimiati M. Pengaruh Frekuensi Pendidikan Gizi Dengan Media Video Motion Graphic Tentang Anemia Terhadap Pengetahuan Dan Pola Konsumsi Siswi SMAN 72 Jakarta Utara. J Andaliman J Gizi Pangan, Klin dan Masy [Internet]. 2021;1(1):31–8. Available from: https://jurnal.unimed.ac.id/2012/index.php/jgpkm/article/view/24926/16146

13. Hanley-Cook GT, Hoogerwerf S, Parraguez JP, Gie SM, Holmes BA. Minimum Dietary Diversity for Adolescents: Multicountry Analysis to Define Food Group Thresholds Predicting Micronutrient Adequacy among Girls and Boys Aged 10–19 Years; Defining food group diversity thresholds for adolescents. Curr Dev Nutr. 2024;8(3).

14. FAO. Minimum Dietary Diversity for Women : An updated guide for measurement from collection to action [Internet]. 2021. 1–176 p. Available from: https://doi.org/10.4060/cb3434en

15. Singh SK, Garg G, Davey S, Kumar Raghav S, Muzammil K, Vir Singh J, et al. Impact of Educational Status of Parents on Nutritional Statusof Adolescent Girls-a Cross Sectional Study. Natl J Community Med [Internet]. 2014;0976(3):3. Available from: www.njcmindia.org

16. Alavi M, Eftekhari MB, Noot R, Rafinejad J, Chinekesh A. Dietary habits among adolescent girls and their association with parental educational levels. Glob J Health Sci. 2013 Jul;5(5):202–6.

17. Belew AK, Sisay M, Baffa LD, Gasahw M, Mengistu B, Kassie BA, et al. Dietary diversity and its associated factors among adolescent girls in Ethiopia: a systematic review and meta-analysis. BMC Public Health. 2024;24(1).

18. Nyma Z, Rahman M, Das S, Alam MA, Haque E, Ahmed T. Dietary diversity modification through school-based nutrition education among Bangladeshi adolescent girls: A cluster randomized controlled trial. PLoS One [Internet]. 2023;18(3):e0282407. Available from: https://doi.org/10.1371/journal.pone.0282407

19. Nahar MZ, Zahangir MS. The role of parental education and occupation on undernutrition among children under five in Bangladesh: A rural-urban comparison. PLoS One. 2024;19(8):e0307257.

20. Vaida DN. Impact of Maternal Occupation on Health and Nutritional Status of Preschoolers. (In Srinagar City). IOSR J Humanit Soc Sci. 2013;7(1):9–12.

21. Roche ML, Bury L, Yusadiredjai IN, Asri EK, Purwanti TS, Kusyuniati S, et al. Adolescent girls' nutrition and prevention of anaemia: A school based multisectoral collaboration in Indonesia. BMJ. 2018;363:1–6.

22. Medeiros GCBS de, Azevedo KPM de, Garcia D, Oliveira Segundo VH, Mata ÁN de S, Fernandes AKP, et al. Effect of school-based food and nutrition education interventions on the food consumption of adolescents: a systematic review and meta-analysis. Int J Environ Res Public Health [Internet]. 2022;19(17):10522. Available from: https://doi.org/10.3390/ijerph191710522

23. Contento IR. Nutrition Education ; Linking Research, Theory and Practice [Internet]. 2nd ed. Vol. 11, Analytical Biochemistry. Canada: Jones and Bartlett Publishers, LLC; 2011. Available from: http://link.springer.com/10.1007/978-3-319-59379-1%0Ahttp://dx.doi.org/10.1016/B978-0-12-420070-8.00002-7%0Ahttp://dx.doi.org/10.1016/j.ab.2015.03.024%0Ahttps://doi.org/10.1080/07352689.2018.1441103%0Ahttp://www.chile.bmw-motorrad.cl/sync/showroom/lam/es/

24. Ronto R, Ball L, Pendergast D, Harris N. Adolescents' perspectives on food literacy and its impact on their dietary behaviours. Appetite [Internet]. 2016;107:549–57. Available from: https://doi.org/10.1016/j.appet.2016.09.006

25. Yahia N, Brown CA, Rapley M, Chung M. Level of nutrition knowledge and its association with fat consumption among college students. BMC Public Health [Internet]. 2016;16:1–10. Available from: https://doi.org/10.1186/s12889-016-3728-z

26. Dewi NKT, Kayanaya AAGR, Kencana IK. Pengaruh Penyuluhan Dengan Media Video Terhadap Pengetahuan Anemia Dan Asupan Konsumsi Zat Besi. J Ilmu Gizi J Nutr Sci. 2023;10(4):229–36.

27. Michie S, Van Stralen MM, West R. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. Implement Sci [Internet]. 2011;6:1–12. Available from: https://doi.org/10.1186/1748-5908-6-42

28. Sandela D, Besmaya BM, Veronica SY, Anggriani Y. The Effect Of Video-Based Education On Adolescents ' Knowledge About Anemia At SMP Negeri Satap 11 Mesuji In 2024. 2024;15(04):1303–11.

29. Rodliah S, Wulandatika D, Fatimah S. Effectiveness of video versus leaflet education on anemia prevention knowledge among young women: A comparative study. 2024;7(1):50–5. Available from: https://doi.org/10.31101/jhtam.3561

30. Madestria N, Moedjiono A, Suriah, Tahir M, Masni, Suarayasa K, et al. Effect of education through video and packaging modifications of iron tablets on female adolescent behavior in the iron supplementation intake in SMPN 2 and SMPN 1 Parigi. Gac Sanit. 2021 Dec 17;35:S127–30.

31. Márquez-Ibarra AA, Valbuena-Gregorio E, Mariscal Ramírez BE, Barrera-Hernández LF. Dietary diversity, iron and vitamin A intake in university students from northwestern Mexico. Nutr Clin y Diet Hosp. 2024;44(2):166–72.

32. Kuchenbecker J, Jordan I, Reinbott A, Herrmann J, Jeremias T, Kennedy G, et al. Exclusive breastfeeding and its effect on growth of Malawian infants: results from a cross-sectional study. Paediatr Int Child Health [Internet]. 2015;35(1):14–23. Available from: https://doi.org/10.1179/2046905514y.0000000134

33. Yazew T, Kuyu CG, Beressa G, Seyoum G. Effect of nutrition education on dietary diversity and academic achievement among adolescent school girls in North Shoa Zone, Oromia, Ethiopia. Nutrition. 2024 Jul;123:112416.